AAR-100

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<u>CAMI Research Report</u> **–** ***Access-to-Egress: A Meta-Analysis of the Factors that Control Emergency Evacuation through the Transport Airplane Type-III Over Wing Exit***

Background. The factors that control emergency evacuation from transport aircraft are many. The physical factors include the aircraft structure and the configuration of aircraft interior components such as aisles, seating arrangements, monument placements, and crewmember assist spaces. Information factors related to emergency evacuation include safety briefing cards and videos, signs, placards, emergency lighting and marking systems, and verbal briefings by the crew. Trained crewmembers perform the functions necessary to initiate and conduct emergency evacuations, providing passenger management functions intended to produce fast and effective evacuations. Individual passengers have a large, typically negative impact on the conduct of emergency evacuations, resulting from their general naivete regarding aircraft emergencies and the proper procedures needed to cope with such circumstances. Egress through the Type-III over wing exit is particularly susceptible to this deficiency, since passengers typically must operate the exit as well as use it.

Results. Research efforts conducted to define the relative contributions of these factors have been focused to a large degree on the interior configuration of transport aircraft, attempting to establish the appropriate access-to-egress required. These studies have employed an array of techniques and posited as assortment of experimental questions designed to address the issue, resulting in a comprehensive body of evidence related to access-to-egress, particularly for the Type-III exit. Additional information has been provided about many of the other factors that also exert control of evacuations, allowing assessments to be made regarding the relative importance of individual factors, and their various combinations, on the outcome of emergency evacuations. This analytical review of the studies conducted to address access to the Type-III exit has confirmed that human factors effects related to passengers present the biggest challenge to the execution of successful evacuations. Deficiencies that may exist regarding configural and informational egress are expressed through their interactions with these human factors effects, which have often made determination of specific deficiencies more difficult. Solutions to overcoming deficiencies must address both the specific deficiency and its interactiveness.

Conclusions

- Human factors effects predominate in controlling evacuation performance and obscure the effects of other evacuation factors. Controlling human factors (and other confounding) effects is necessary to clarify the effects of other factors, such as passageway configuration.
- Forward encroachment of the exit row aft seat assembly to the midline of the exit gives better egress flow rates, although lesser seat encroachment distances are acceptable.
- Passageways between 13" and 25" provide essentially equivalent egress flow rates, whereas those with greater or narrower (especially for older passengers) widths are less effective.
- Blockages of the Type-III exit by subjects during competitive evacuation trials is related more to the attitudes and motivation levels of individual subjects, not passageway configuration, as blockages or extremely delayed evacuations have occurred at almost all studied passageway widths.
- Exist plug removal and disposal is affected little by passageway configuration, although the placement of the plug after removal has been shown to be variable, resulting from poor instruction about what to do with it. Exit designs that include automatic disposal, and/or better instructions for passengers who must open exits could alleviate this problem.
- Information materials, such as safety briefing cards related to emergency evacuation activities have been poorly rendered, as passengers cannot understand the intent of the materials or do not seem obliged to read and follow instructions.
- Provision of a flight attendant can organize passenger behavior during both actual and experimental evacuations, without producing idiosyncratic effects or interactions that necessarily render the results of evacuation studies inapplicable to rulemaking.
- Interactions between evacuation system elements (physical information, operator and user) are generally linear and physically circumscribed to the area of the exit opening.
- There should be no reliance on one class of evacuation system elements (physical, information, etc.) to overcome deficiencies in another. Regulatory strategies adhere to this principle by having multiple rules related to both single and multiple evacuation factors. These include rules on exit size and passenger ratings, exit distribution, descent assisting means, emergency lighting, safety briefing cards, signs, placards, emergency procedures, and crew emergency training, to name a few.

(McLean, Garnet A., (January 2001). Access-to-Egress: A Meta-Analysis of the Factors that Control Emergency Evacuation through the Transport Airplane Type-III Over Wing Exit. Oklahoma City. OK: DOT/FAA/AM-01/2. Available online: http://www.cami.jccbi.gov/AAM400a/abstracts/2001techrep.htm

Human Factors News

Emhanced Vision/Situational Awareness: Dr. William K. Krebs (AAR-100) and Dr. Albert J. Ahumada (NASA-Ames) were invited to present a paper entitled "Combating Uncertainty with Fusion" at an Office of Naval Research/NASA/Marine Biological Laboratory-sponsored workshop held at the Erik Jonsson Center for the National Academy of Sciences in Woods Hole, MA, April 22-24, 2002. The objective of the meeting was to address a class of difficult computational problems that are characterized by combining large amounts of data or data sets

from diverse sources that are related in complex, stochastic, and possibly poorly understood ways. Dr. Krebs presented a computational model based on human behavior that can evaluate image sensor fusion scenes. He also provided examples of sensor fusion scenes recently collected from the AAR-100 enhanced vision research project that collected infrared and visible data at Naval Air Station Patuxent River, MD. The abstract of the talk is described below. (W.Krebs, AAR-100; A. Ahumada, Jr., NASA-Ames)

Using an Image Discrimination Model to Predict the Detectability of Targets in Color Scenes

Sensor fusion combines images from multiple sensors into a single display, with the aim of enhancing operators' target detection and situational awareness in high-workload environments. Numerous researchers (Toet & Walraven, 1996; Therrien, Scrofani, & Krebs, 1997; Waxman *et al.*, 1997; Scribner, *et al.*, 1998) have proposed sensor-fusion algorithms that might perform as well as or better than single-band imagery, however human performance studies have not shown consistent benefits for fused multi-band over single-band imagery (Krebs & Sinai, in press). **Objective**: The goal of the research is to develop an image discrimination model that can predict the detectability of targets in color scenes. This model would need to be a fairly robust and accurate predictor of the detectability of a target in a sensor-fused scene to obviate the need of performing human performance studies. **Methods**: Images were collected with visible, mid-wave, and long-wave infrared sensors and then combined by an image fusion algorithm. Observers' reaction times and accuracy scores were collected in a variety of visual search tasks using single and dual-band imagery. Similar scenes were used as maskers of simple luminance and chrominance targets. **Results**: Visual search results found that sensor fusion did not improve performance relative to that obtained with single-band imagery on a target detection task. Moreover, these experiments demonstrate significant masking of color targets by color variations in the background texture. An image discrimination model was developed to predict the effects of masking of luminance and chromatic targets by color variations in the background scene. **Conclusions**: Actual or potential applications of this research include a quantitative methodology to evaluate the performance of an image-fused algorithm for automobile, aviation, and maritime applications.

ADS-B: As part of its university research grant assessing ADS-B capabilities relative to controller information requirements and decision strategies, a researcher from Embry Riddle Aeronautical University (ERAU) along with staff from the National Aviation Research Institute and AAR-100 completed a site visit to the Houston en route center. Houston center has an average 4,000 flight legs on a typical VFR day associated primarily with oil rig helicopter traffic activity in the Gulf of Mexico, and that count drops to about 100 legs on an IFR day. These non-radar operations during IFR days could benefit from ADS-B surveillance information. The ERAU simulation study will assess controller use of ADS-B display information for ATC operations. (P. Krois, AAR-100)

GADIT: The final meeting of the second phase of the General Aviation Data Improvement Team (GADIT) was held at the General Aviation Manufacturers Association (GAMA) office in Washington, DC April 24th and 25th. The GADIT is part of the FAA's *Safer Skies* effort and includes members from the government and industry. The focus of phase II is to improve the 'richness' of data included in general aviation accident and incident reports. Over the last nine

months, the team has met regularly to identify data needs, propose solutions, evaluate the effectiveness and feasibility of those solutions, and ultimately make recommendations to the *Safer Skies* General Aviation Joint Steering Committee (JSC). With the conclusion of the meeting, a list of solutions and recommendations has been compiled. A final report to the JSC is being prepared (S. Shappell, CAMI).

DoD Technical Advisory Group (TAG) Meeting: Dr. Thomas Nesthus (CAMI/AAM-510) participated as co-chair of the Sustained and Continuous Operations SubTAG during the 47th DoD Human Factors Engineering Technical Advisory Group meeting in San Diego, CA April 29-May 3, 2002. The following presentations were made: (1) "Team Fatigue Research: A Multi-level Approach using Synthetic Task Environments." L. R. Elliott and Lt. L. Brown, AFRL/HE, Brooks AFB TX; (2) "A Comparison of Three Submarine Watchstanding Schedules: A Preliminary Report". J. Miller AFRL/HE, Brooks AFB, TX, LT J. Dyche HMCS, J. Bertoline, NSMRL, Groton CT, and LT W. Carr, NHRC, San Diego CA: (3) "A Laboratory Evaluation of Performance Following a Day Nap Under Zaleplon and Placebo Conditions". J. N. Whitmore, Veridian, AFRL/HEAS, Brooks AFB, TX, J. R. Fischer, Jr., Veridian, AFRL/HEAS, Brooks AFB, TX and William F. Storm AFRL/HE, Brooks AFB, TX; (4) "The Efficacy of Dexedrine for Overcoming Sleep Deprivation in Aviators". J. Caldwell, AMEDD/USAARL, Ft. Rucker AL; and (5) "Improving Nightshift Performance by Prolonging Daytime Sleep with Temazepam". J. L.Caldwell AMEDD/USAARL, Ft Rucker, AL. Additionally, an offsite meeting was held with members from Brooks, AFB and NHRC to discuss the SAFTE Performance/Fatigue Modeling efforts of Steve Hursh (SAIC) and the Fatigue Avoidance Scheduling Tool (FAST) efforts of Tim Elsmore (NTI, Inc). Research and product improvements through DOT FRA and DoD USAF contracts provided interest to those in attendance. Discussion also involved the International Modeling meeting that will be held following the APSS meeting in Seattle, WA on June 13-14, 2002. (T. Nesthus, CAMI)

Aviation Security: There is a "Viewpoint" column in the March 25, 2002 Aviation Week & Space Technology written by former FAA'ers Bob Francis and Denise Daniels. The piece is titled "Human Factors Insights Can Aid Aviation Security." A main theme is that one of the TSA's and DOT's greatest challenges will be to "manage the great -- and sometimes unrealistic -- expectations of travelers, the media and some in the transportation community regarding the performance of our new security systems." The authors say that creating a TSA, federalizing the screeners, and giving screeners better training and benefits will not of themselves lead to a "faultless and seamless functioning of the security system." (G. Lavey, AOA-5)

Flight Strip Research: A CAMI researcher met with Dr. Frank Durso, Texas Tech. University, to discuss several research projects included in his grant "Flight Data Representations: Do Previous Findings Generalize". They updated a research proposal to observe systematically how flight strips are used in towers. They also updated a research proposal to analyze archival and survey data to identify similar groups of facilities that will receive URET in the Free Flight Phase 2 program and have similar flight strip usage patterns. Finally, they discussed the design of a simulation study that will be conducted this summer using AAM-500's Air Traffic Control Advanced Research Simulator. (C. Manning, CAMI)

Aerospace Medicine Award: Dr. Julia Pounds attended the Aerospace Medicine Awards for Excellence and Achievement ceremony that was held in Costa Mesa, CA on April 17, 2002. She

received the Outstanding Leadership Award for her role in the development and implementation of the beta test of the JANUS human error framework. The beta test involves the application of JANUS to identify the human factors associated with operational errors/incidents and runway incursions. (D. Schroeder, CAMI)

JANUS

- In April, CAMI researchers visited several FAA ATC facilities in Southern New England and the Great Lakes Region to test the JANUS technique for identifying causal factors related to operational errors. JANUS is still in its beta test phase and researchers are "on call" to visit facilities upon joint request from air traffic management and NATCA. During these visits, the researchers facilitate a structured data collection process with volunteer participants. (J. Pounds, CAMI)

- Members of the JANUS project team provided informational briefings to personnel at ZAU, MSP, and SEA. Members are Julia Pounds (AAM-510), Luis Castro (AAT-200), Scott Keller (D10 NATCA), and Jim Beadling (ATL NATCA). The team provided oversight of the beta test process and met for an interim assessment at the ANM regional office. While in Seattle, the team gave a project briefing to Jim Greene (ANM-1R) and other members of the ANM Runway Safety Office. Larry Cole (ARI-100) attended the Seattle briefings and provided feedback to the team. (J. Pounds, CAMI)

- Julia Pounds (AAM-510) gave a presentation at the Annual Runway Safety Symposium held by the FAA's Runway Safety Program and the Alaska Region, April 24-25, 2002. Topic of the presentation was the technique being developed to identify human factors related to runway safety. The ATC version of the technique which is currently being beta tested in some FAA ATC facilities was described. Potential uses, outcomes, and benefits of a 360-degree common approach incorporating flight and surface operations were presented. (J. Pounds, CAMI)

More information on human factors research can be found at the FAA Human Factors (AAR-100) web site: http://www.hf.faa.gov

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May 5-9, 2002 – 73rd Annual Scientific Meeting of the Aerospace Medical Association, Queen Elizabeth's Hotel, Montreal, Canada http://www.asma.org/

May 6-12, 2002 – International Aerospace Exhibition and Conference, Berlin Brandenburg International Airport, Berlin, Germany http://www.ila-berlin.com/

May 20-22, 2002 – 11th Annual Phoenix International Aviation Symposium, The Phoenician Resort, Phoenix, AZ http://www.phxskyharbor.com/

May 28-30, 2002 – EBACE2002, Geneva, Switzerland http://www.ebace.com/

June 13-14, 2002 – Aviation Conference and Exposition, Oklahoma City, OK mailto:skymarket@aol.com

August 27-30, 2002 – Measuring Behavior 2002, 4th International Conference on Methods and Techniques in Behavioral Research, University of Amsterdam, Amsterdam, The Netherlands http://www.noldus.com/events/mb2002/index.html

September 16-18, 2002 – Conference on Aerospace Materials, Processes and Environmental Technology, Huntsville, AL http://ampet.msfc.nasa.gov/

September 17-18, 2002 – FAA R,E&D Advisory Committee, Holiday Inn Rosslyn Westpark Hotel, Arlington, VA mailto:gloria.ctr.dunderman@faa.gov

September 17-20, 2002 – International Air Cargo Forum, Hong Kong http://tiaca.org/

September 30- October 4, 2002 – Human Factors and Ergonomics Society 46th Annual Meeting, Baltimore Waterfront Marriott Hotel, Baltimore, MD http://www.hfes.org/

October 14-16, 2002 – Third LOSA Week, Dubai, United Arab Emirates mailto:dmaurino@icao.int

October 23-25, 2002 – International Conference on Human-Computer Interaction in Aeronautics, Massachusetts Institute of Technology, Cambridge, MA http://www-eurisco.onecert.fr/events/hci-aero2002.html/

October 27-31, 2002 – 21st Digital Avionics Systems Conference, Hyatt Regency Hotel, Irvine, CA http://www.dasconline.org/

April 7-27, 2003 – Aviation World's Fair, Newport News/Williamsburg, VA http://www.worlds-fair.com/ or http://aviation-worlds-fair.com/

May 4-9, 2003 – 74th Annual Scientific Meeting of the Aerospace Medical Association, Convention Center, San Antonio, TX http://www.asma.org/

October 13-17, 2003 – Human Factors and Ergonomics Society 47th Annual Meeting, Adams Mark Denver Hotel, Denver, CO http://www.hfes.org/

May 2-7, 2004 – 75th Annual Scientific Meeting of the Aerospace Medical Association, Egan Convention Center, Anchorage, AK http://www.asma.org/

September 20-24, 2004 – Human Factors and Ergonomics Society 48th Annual Meeting, Sheraton New Orleans Hotel, New Orleans, LA http://www.hfes.org/

Note: Calendar events in Italics are new since the last Newsletter

Comments or questions regarding this newsletter?
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